June 15, 2015 **WORKING DRAFT VERSION 5**

Mark Woodke, Chemist, CHMM
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Seattle, WA 98104

Dear Mr. Woodke:

Review of the GC/FID traces generated during the analysis of the NWTPH Diesel at Friedman & Bruya for your 10PB Site was completed in order to provide cursory information regarding the nature of any contamination present in the samples identified below. Included in each description is a recommendation for further analysis and or review in order to further characterize the contamination, if warranted.

Source Group: This group contains product samples presumably collected from USTs or ASTs in the study area. Identification of the fuel types based on review of the GC/FID traces is as follows:

- **Pump 2 and Pump 5:** These samples consist of an undegraded "biodiesel" such as B2 or B5. More specifically, the fuel present is a mixture of a middle distillate such as diesel fuel #2 or similar fuel with what appears to be a non-petroleum derived constituent which can be seen as a single dominant peak eluting near nC21 or 3.9 minutes. Additional testing for HFS, Total Sulfur and/or EPA Method 8270 can be completed, if warranted, to further characterize the fuel present in these samples including confirmation testing of the nature of the non-petroleum sourced constituent near nC21.

- **Pump 3 and Pump 4:** These samples contain undegraded, reformulated gasoline. Further testing by EPA Method 8260C, HFS, and/or the PIANO Method can be completed, if warranted, to further characterize the refinery characteristics, additives, and blending components in the fuel. If the AST/USTs were abandoned historically, additional testing for organometallic additives would also be recommended.

- **Stove Oil:** This sample contains an undegraded middle distillate such as kerosene, diesel fuel #1 or similar fuels. Additional testing for HFS and Total Sulfur can be completed if further characterization is warranted.

Group A: This group contains samples where contamination was not detected above 250 ppb in ground water and 50 ppm in soil. This includes samples IR04GW, IR-01GW, BH05GW, BH09-GW, BH08GW, BH-06GW, BH11 SB12, BH11GW, BH10GW, BH14 GW, BH09SB12, BH20GW, BH17GW, BH18GW, and BH19GW. .Although a series of irregular peaks, besides the solvent front and surrogates, does show up generally on the GC/FID traces of several of these samples this material is lab contamination as it is also present in the associated method blank. However, it should also be noted that the samples IR04GW, IR-01GW, and BH05GW contain a low level of a medium to high boiling unresolved complex mixture (UCM) or hump which elutes in the lube oil range. This material may be polar and/or non-polar in origin and could potentially be related to lab contamination but a site source could not be ruled out without further evaluation. If there is concern over trace levels of a high boiling material we would recommend running the extracts through silica gel and re-analyzing by NWTPH-D to determine if the material is polar in origin, or not.

Group B: This group contains samples that have likely been impacted with automotive gasoline or a similar material (some of these samples are also in Group C as diesel fuel is also present in some of the samples). These samples include BH04GW, BH01 GW, BH12GW, BH12GW (6/3/2015), BH21GW, BH26GW, and TP02GW. In order to further characterize the low boiling product present in these samples we recommend evaluating any available VOC data (such as generated by EPA Method 8260C including evaluation of all oxygenates and lead scavengers, NW-TPH G, and/or similar data) for all samples. In addition, we recommend running a Hydrocarbon Fuel Scan (HFS), or GC Fingerprint, on the sample BH01 GW(completed), BH12GW(completed), and TP02GW (completed). The level of gasoline present in the remaining samples is too low for the HFS analysis.

Group C: This group contains sample that have been impacted by a middle distillate such as diesel fuel #2 or similar fuels in varying states of weathering (some of these samples are also in Group B as gasoline is also present is some of these samples). These samples include BH01 SB16, BH015B13, BH12GW, BH01GW, BH12GW (6/3/2015), and TP02GW. The samples BH01 SB16 and TP02GW are impacted by diesel fuel #2 which has undergone little to no biological degradation based on the dominant pattern of normal alkanes present on the GC/FID traces. The samples BH015B13, BH12GW, and BH12GW (6/3/2015) are impacted by diesel fuel #2 that has undergone substantial biological degradation based on the absence of normal alkanes on associated GC/FID traces. The sample BH01GW is impacted by diesel fuel #2 that is either moderately degraded or a mixture of biologically degraded and undegraded fuel based on the relative abundance of normal alkanes and isoprenoids on the GC/FID trace. We recommend running the samples BH01 SB16, BH015B13, BH12GW(completed), BH01GW(completed), and TP02GW (completed) for HFS analysis if further characterization is warranted.

Group D: This group contains only the sample MH01WW and the nature of the material is unknown. The material is medium to high boiling and elutes on the GC/FID trace as a series of isolated, irregular peaks with two dominant peaks around 4 minutes. These compounds may be polar and/or non-polar in origin and could possibly be related to a surfactant. If further characterization is warranted we recommend analysis using EPA Method 8270 in full scan mode with TIC reporting to attempt identification of the specific components of the material. In addition, cleanup of the NW-TPHD methylene chloride extract using silica gel would also be useful in evaluating what portion, if any, if the material is polar in origin.

Hydrocarbon Fuel Scan (HFS) Results:

The GC/FID Fingerprinting of the samples BH01 GW **and TP02GW** confirmed the presence of reformulated automotive gasoline and a middle distillate in these samples. The majority of fuel present is gasoline as shown by the dominant peaks indicative of toluene, the xylenes, and C3-benzenes on the GC/FID traces. The abundance of toluene in the samples BH01 GW **and TP02GW** compared to that expected in a typical undegraded gasoline indicates that the fuel present has undergone limited to no weathering. **Furthermore, the level of toluene present in the sample TP02GW is significantly higher than that identified in the sample BH01 GW indicating that these locations are impacted by two or more manufacturing batches of gasoline and/or the gasoline at the TP02GW location has undergone less degradation then that present at the BH01 GW location.**

The low level of the middle distillate present in the samples BH01GW **and TP02GW** can be seen eluting from approximately 8 to 24 minutes on the GC/FID traces and is indicative of diesel fuel #2. Within this range there is a dominant pattern of normal alkanes that are gaussian in distribution except for a peak at approximately *n*C21. The abundance of normal alkanes indicates that the fuel has undergone little to no biological degradation. **The peak at approximatley *n*C21, which is not gaussian in distribution, indicates that at least a portion of the fuel present in the samples BH01GW and TP02GW is likely biodiesel such as identified in Source Group Pump 2 and Pump 5.**

The GC/FID Fingerprinting of the sample BH12 GW confirmed the presence of reformulated automotive gasoline and a middle distillate in the sample. The majority of fuel present is gasoline as shown by the dominant peaks indicative of toluene, the xylenes, and C3-benzenes on the GC/FID trace. The abundance of toluene in the sample BH12GW compared to that expected in a typical undegraded gasoline indicates that the fuel present has undergone limited to no weathering. **In addition, comparison of the proportion of toluene in the sample BH12GW to the samples BH01GW and TP02GW indicates that either the gasoline in BH01GW and TP02GW is more degraded than BH12GW and/or multiple manufacturing batches of gasoline have impacted these samples.**

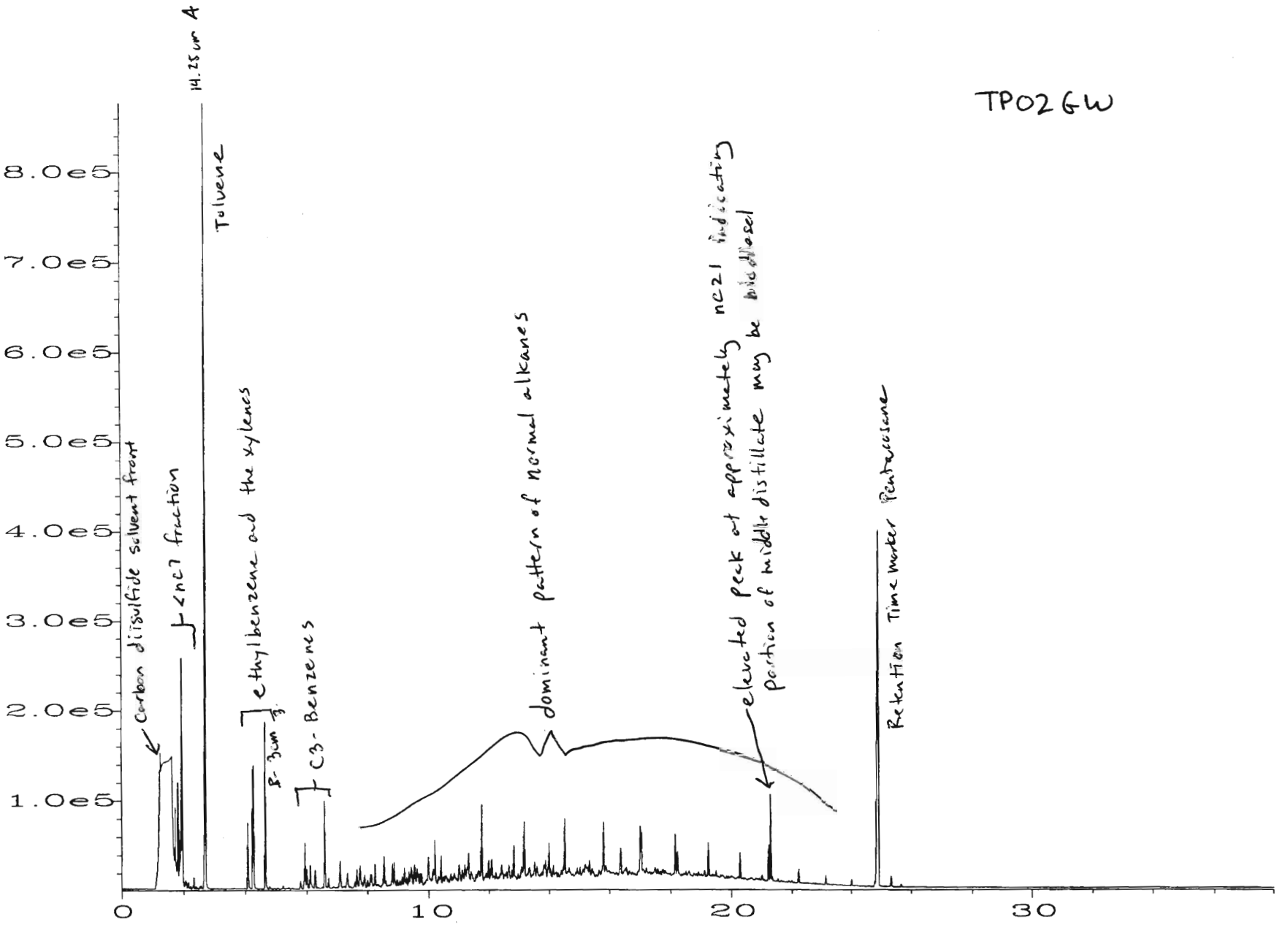
The trace level of the middle distillate present in the sample BH12GW can be seen eluting from approximately 8 to 24 minutes on the GC/FID trace. Within this range there is a dominant pattern of peaks indicative of isoprenoids such as norpristane, pristane, and phytane. The GC/FID trace also shows an apparent absence of normal alkanes. The middle distillate present in the sample BH12GW is indicative of diesel fuel #2 and the reduced level of normal alkanes indicates that the fuel has undergone substantial biological degradation.

Please contact us if additional consultation is needed by our firm in the interpretation of these analytical results. We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Respectfully,

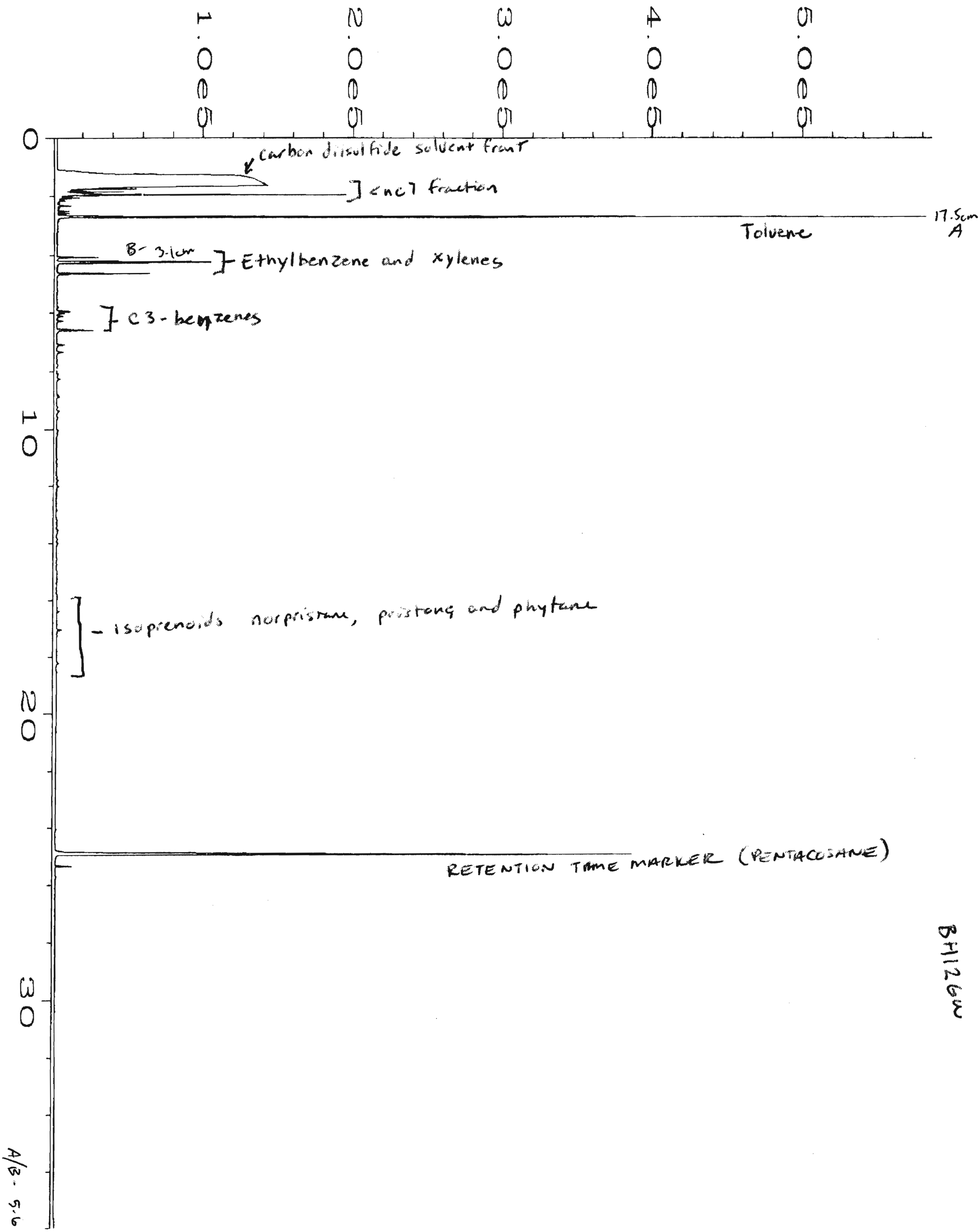
Kurt Johnson
Principal, Chemist

TP02GW



A/B- 4.75

Sig. 1 in C:\HPCHEM\5\DATA\06-16-15\004F0401.D



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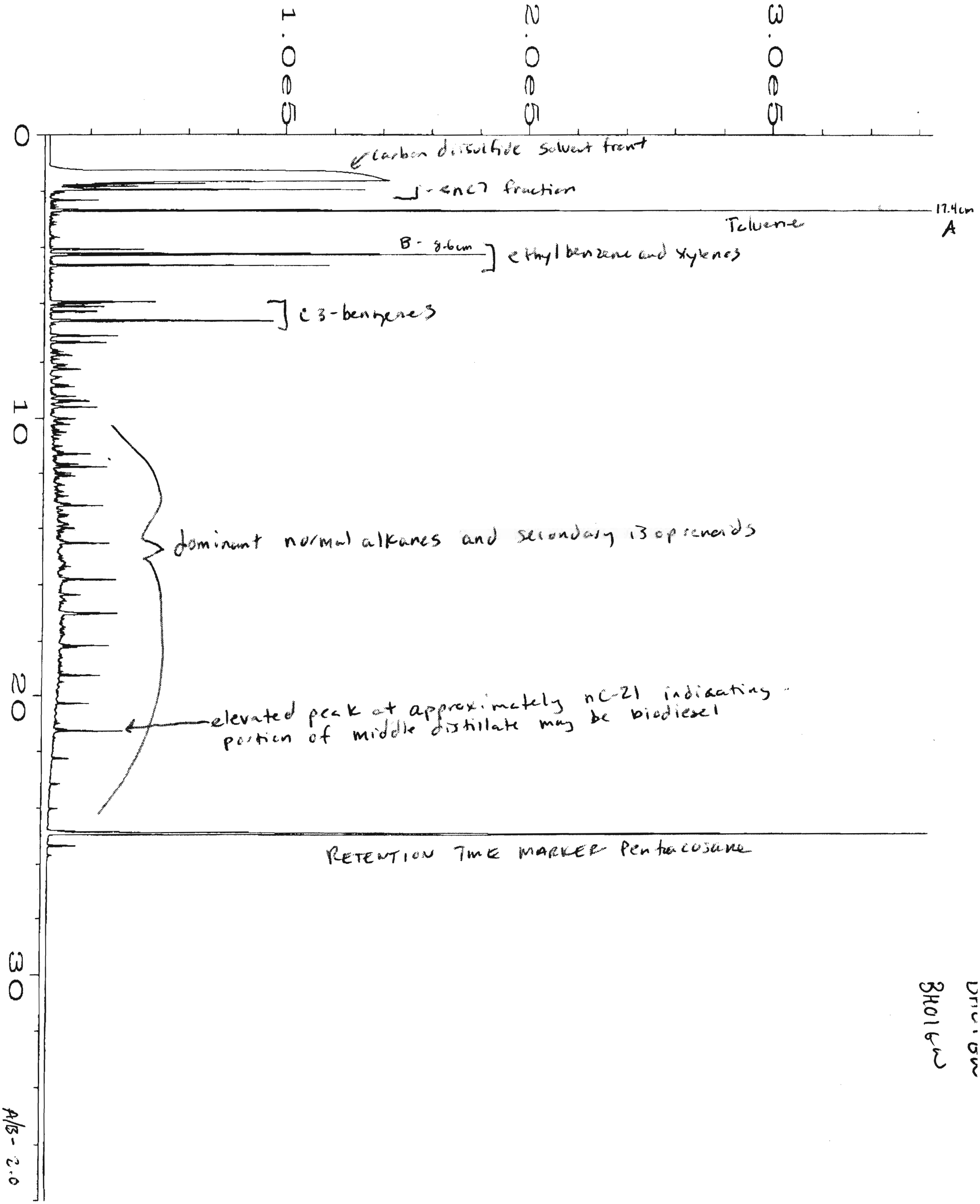
2.0e5
3.0e5
4.0e5
5.0e5
0
10
20
30
carbon disulfide solvent front
] <nc7 fraction
17.5cm
A
Toluene
B- 3.1cm
} Ethylbenzene and xylenes
} C3-benzenes
- isoprenoids norpristane, pristane and phytane
RETENTION TIME MARKER (PENTACOSANE)
BH12GW
A/B- 5.6



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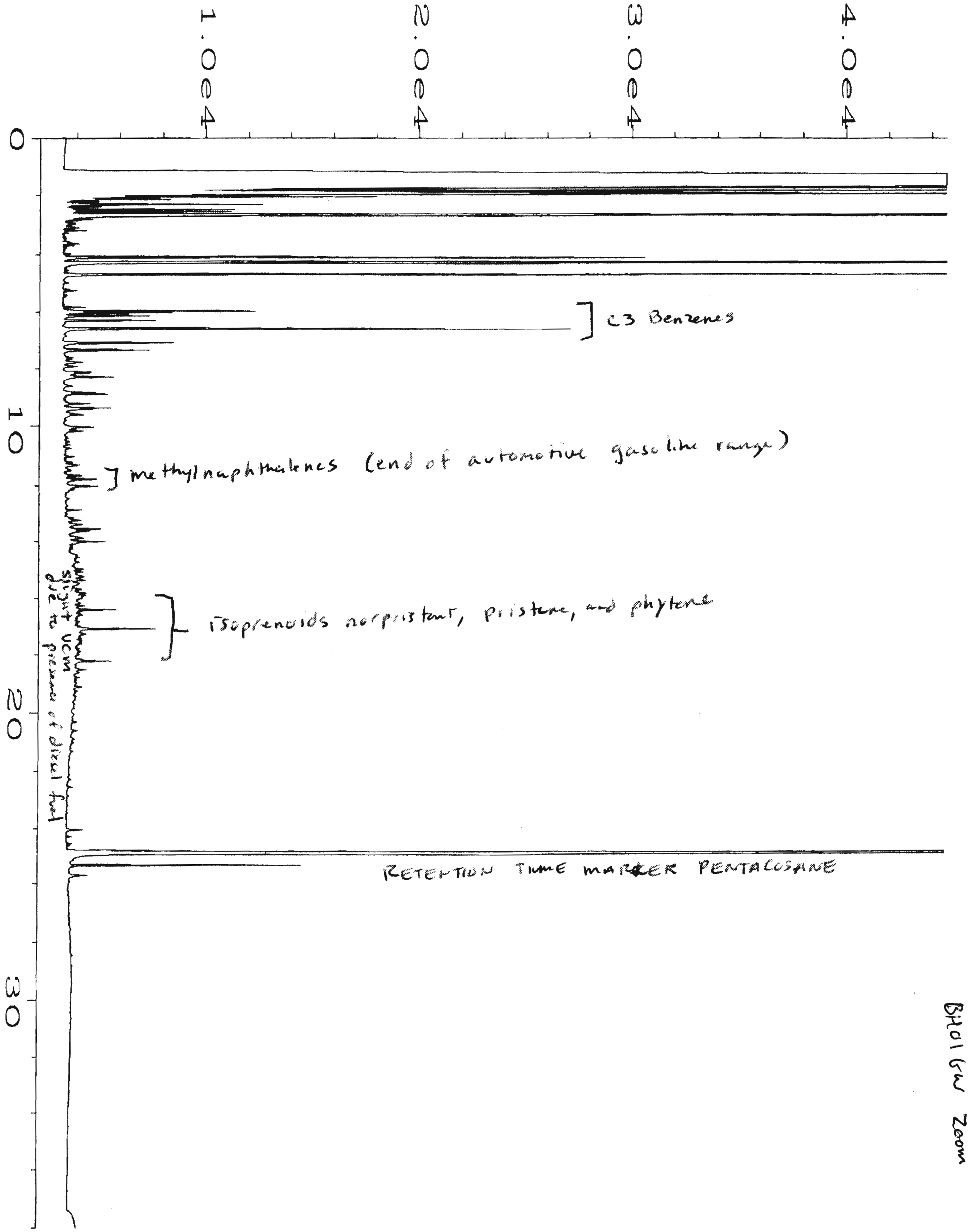
3.0e5
0
10
20
30
carbon disulfide solvent front
-nC7 fraction
17.4cm
Toluene
A
B - 8.6cm
ethylbenzene and xylenes
C3-benzenes
dominant normal alkanes and secondary isoprenoids
elevated peak at approximately nC-21 indicating portion of middle distillate may be biodiesel
RETENTION TIME MARKER Pentacosane
A/B - 2.0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4.0e4
0
10
20
30
C3 Benzenes
methylnaphthalenes (end of automotive gasoline range)
isoprenoids norpristane, pristane, and phytane
slight UCM due to presence of diesel fuel
RETENTION TIME MARKER PENTACOSANE
BH01 GW Zoom